Upper extremity case report

14-year-old male with diagnosis of Cerebral Palsy with high muscle tone and lost range of motion in multiple joints

This 14-year-old white male has had a diagnosis of cerebral palsy from birth. He has high muscle tone in all regions of the body. Although he has increased muscle tone and lost range also in his lower extremities, today we are only addressing his left upper extremity.

- When on his back he frequently holds his arms above his shoulders creating *muscle memory* to make that position his "normal." This position lengthens the muscles that are stretched and encourages the opposing muscles to shorten, and this position puts stress on his shoulder joints. It also adversely affects his hands as they lay on a surface which tends to create lost range. (see the third picture below – the thumb is being pushed into and held in thenar eminence collapse from the wrist, and the wrist joint is in flexion.)
- He has lost range at both elbows, bilateral wrist flexion that is worse in the left, bilateral thenar eminence collapse, left hand/wrist pronation, and left ulnar drift at the wrist. How much of this is his high muscle tone and how much is from positioning? How much is resulting from the pressure from surfaces his hands touch, and how much is deformity is the result of gravity?

Let's discuss his left upper extremity in the three pictures below. The first two are of him sitting in his custom wheelchair, the third is of him lying supine.

THE PICTURES ABOVE:

The first picture: Left lower arm rotated from the elbow, the weight of his hand encourages the downward position.

The second picture: What appears to be an addition to his custom wheelchair to perhaps prevent his hand from going farther back but it is encouraging severe wrist flexion and not discouraging the backward rotation which is stretching the shoulder, elbow, wrist and entire left upper extremity.

The third picture shows the surface on which he is lying stopping the extreme backward rotation but allows the backward shoulder rotation to that degree, with no encouragement toward normal. The thenar eminence is pushed into collapse and the wrist is in extension. Note the elbow joint itself is abnormal.

THE PICTURES DIRECTLY ABOVE: These pictures were taken within 20 minutes of his fitting. He is shown wearing bilateral RM Restorative Hand splints, the left has Ulnar Drift Strapping and an extra "bumper pad" at the medial side of that wrist to help to begin to bring the hand/wrist back into normal alignment correct the ulnar drift from the wrist. The parents were shown how to gently stretch and lift the thumb back toward normal before putting on the hand splint so the

hand splint base and strapping can support that corrected hand posture. The straps of any RM hand splint can be sewn on as Ulnar Drift Strapping. They create 3-point leverage to realign the fingers/hand/wrist/lower arm toward and to normal alignment. An adjustable "bumper pad" is placed typically at the medial side of the wrist to provide the required extra push to correct ulnar drift at the wrist.

Fitting the hand splints: The left MCPs were molded into approximately 40 degrees of flexion and the fingers into slight flexion (see the right hand in the second picture), and the left wrist was remolded to encourage the comfortable stretching of the wrist toward normal alignment. When fingers are straight and the MCPs are molded into too much extension (too straight), it is not uncommon for any of those joints to begin to hyperextend. This patient exhibits clonus when joints are overstretched so care is taken to not go beyond sub-maximum stretch.

He is also shown with a NeuroFlex® Restorative Elbow splint on his left arm. It was set to apply sub-maximal stretch to relax the increased muscle tone and apply prolonged low load passive stretch to begin to realign the proteins in those muscles to prepare them to be relengthened. He will wear the same type of elbow splint on the right elbow. This will be a lengthy process as his skin has also adapted to the flexed position of the joint, but over time with prolonged wearing of the Flex Technology splint to continue to relax the tone and put mild stretch on the tissue, at least some improvement should be seen. It is very important to prevent further lost range. Continued positioning of both upper extremities as shown with his hand/arms across his chest is also vital to retrain the shoulders to be in that position and create new muscle memory.

A strap was attached to the left hand splint with velcro-like hook, then the opposite end of the same strap was attached in the same manner to the distal cuff (closest to the hand) of the elbow splint to gradually bring that hand around to normal alignment correcting the severe supination.

Conclusion:

The high degree of muscle tone exhibited by this young man - primarily his knees and elbows - commonly leads to lost range of motion "contracture" deformities by holding the adaptive tissue in a shortened length often enough and long enough for it to likely shorten to that length. Although he also has lost range in his lower extremities and the entire body must always be considered when doing Restorative splinting, for this exercise we looked only at his left upper extremity. The same Flex Technology splints are addressing his lower extremities.

It is extremely challenging for the parents and caregivers of these patients that have so many other needs that must be addressed all day long every day. It is vital that Restorative be a routine part of that daily care to help to relax increased muscle tone and prevent contracture deformities. Even though at this time this patient does not have the potential to walk, if his knees contract greater than 75 to 90 degrees in flexion, he will be unable to sit in a chair. That would mean he would always be lying on a floor, on a couch or in a bed and may make it almost impossible for his family to have any type of normal life.

Continual supine lying (one's back) makes it difficult to expand the lungs enough to prevent hypostatic pneumonia. Also, immobility and not enough upright positioning adversely effects every system in the human body and can also lead to pressure sores. Contractures are uncomfortable and may be painful, especially when their body is moved for any reason.

Contractures can make it very challenging to provide adequate hygiene. Example: if a palm closes, it creates a warm, dark, damp, perfect breeding ground for bacteria and fungus. Opening closed palms to provide hygiene is very painful, and as soon as the person stretching the hand open releases it, without an appropriate splint, the hand will close back. As these patients grow and their parents and caregivers age, it may become impossible for them to be cared for at home and they may require institutionalization.

The healthcare needs of these patients are almost always provided by state Medicaid. Maintaining their body in normal alignment can prevent common expenses like oxygen, therapeutic beds and mattresses, custom wheelchairs, surgeries, wound care, repeat hospitalizations, and 24 hour per day professional caregivers.

Patients like this young man may experience fear and stress as he may not cognitively be able to understand why he has so much pain from his contractures during the daily course of his care. Quality of life for he and his family, decreasing the costs of his care, protecting his body from harm, and allowing him to have dignity are all important parts of being a human being and of being good stewards of our tax dollars that go to government and non-government healthcare programs.

Glossary:

Contracture (according to healthline.com) A contracture deformity is the result of stiffness or constriction in the connective tissues of your body. This can occur in your muscles, tendons, ligaments, and skin. You can also experience a contracture deformity in your joint capsules. This is the dense, fibrous connective tissue that stabilizes the joint — and adjoining bones — at the deepest, most internal level.

Contracture deformity restricts normal movement. It develops when your usually pliable connective tissues become less flexible. This means that your range of motion will be limited. You may have difficulty moving your hands, stretching your legs, straightening your fingers, extending another part of your body

Contractures can occur in different parts of your body, such as:

- Muscles. A muscle contracture involves the shortening and tightening of the muscles.
- Joints. If there is contracture in the joint capsule where two or more bones connect, you will experience limited range of motion in that area of your body.
- Skin. Skin may contract where it has been scarred from an injury, burn, or past surgery. This will limit your ability to move that part of your body.

High tone is when the **muscle** is shorter than normal/average and has a tight or rigid feel to it. Your child may have **high** or low **tone** in one or more **muscles** of the body. https://www.ninds.nih.gov/Disorders/All-Disorders/Hypertonia-Information-Page

MCP joints – joints where the fingers joint the hand and allow the fingers to move in flexion and extension

Pressure sores are areas of damaged skin caused by staying in one position for too long. They commonly form where your bones are close to your skin, such as your ankles, back, elbows, heels and hips. You are at risk if you are bedridden, use a wheelchair, or are unable to change your position. https://medlineplus.gov/pressuresores.html

Flex Technology Splints – External body splints that are bioengineered to be able to move with the patients' movements but provide a measured tension against that movement creating a flexible resistance. Typically, within approximately 15 minutes some form of "relaxation" of the increased muscle tone or spasticity is seen and can be felt in the belly of the muscle, inside the elbow joint or behind the knee joint. It may be seen in improved posture including head and neck. These splints are designed to be able to be easily adjusted in some fashion by clinical caregivers to continue the body part on toward and hopefully to normal alignment and maintain them there.

Conventional Splints are rigid splints designed to hold an injured body part in a specific plane to facilitate healing and function. Unlike Flex Technology Splints that allow the muscle to shorten during episodes of tone and spasticity allow the body part to reach a "relaxation" working with the central nervous system.

Restorative is working with joints, body parts and patients' total bodies as necessary to prevent lost range of motion deformities, to restore deformities that have developed as is possible, and maintain improvements. These deformities can be the result of poor positioning, immobility (not using body parts enough to maintain normal tissue lengths), burns, and trauma but most of these contracture injuries are associated with increased muscle tone and spasticity of neurologically involved patients like those who have diagnoses like: cerebral palsy; traumatic brain injury/acquired brain injury/strokes and other brain conditions; spinal cord injuries including whiplash; torticollis; multiple sclerosis; Parkinson's disease; ALS (Lou Gehrig's disease); dementia; and end stage Alzheimer's disease. The damage to the nerves of the Central Nervous System (CNS) can result in either flaccid muscle tone, or more commonly in increased muscle tone. The first step with these patients is to relax this tone. Only then can you determine if there is underlying shortened tissue. Once the tone is relaxed, the same RM Flex Technology Splints provide comfortable prolonged low load passive stretch (LLPS) to begin to realign the proteins in the muscles (Sarcomers) to prepare the tissue to be relengthened. Good Restorative work is holistic and includes support like nutrition, hydration, comfort, good positioning, appropriate motivation and socialization, and well-trained caregivers.

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The views and assumptions in this case study are those of the author and do not necessarily reflect the official policy or position of her employer or company.